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United States
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Animal and
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Biological Control of the Alfalfa Weevil

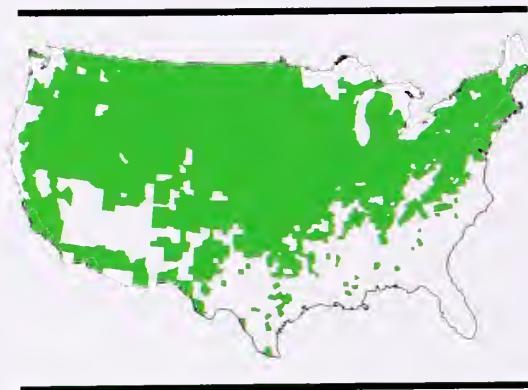


Alfalfa and Its Biggest Pest

Alfalfa is the Nation's leading crop for hay, with 20 to 30 million acres planted annually. It is considered especially desirable for feeding to dairy cattle because of its high protein, calcium, and vitamin content.

The alfalfa weevil is the most serious alfalfa pest in the United States, costing farmers from \$400 million to \$1 billion a year. Sometimes feeding by larvae and adults destroys newly seeded fields outright. The alfalfa weevil can seriously lower both alfalfa yields and the nutritional value of the hay.

Like many of the worst U.S. agricultural pests, the alfalfa weevil is not native to this country. Current information suggests that the two strains found here originated in separate locations in Europe. The alfalfa weevil was first noted near Salt Lake City, UT, in 1904, and a new infestation involving a different strain of the insect was found in the East in 1951. By 1970, alfalfa weevils had invaded fields in all the contiguous 48 States.



Green shading represents areas averaging at least 1 acre of alfalfa per square mile. Alfalfa weevils are found wherever alfalfa grows.

Typical feeding damage sustained by alfalfa. The parasite *Microctonus colesi* is shown here with alfalfa weevil larvae.



Weevil Life Cycle

In most parts of the country, the adult females lay several thousand eggs in the spring, in clusters of 10 to 40. Where winters are mild, egg-laying can take place in the fall or winter. The eggs are deposited inside the stems of alfalfa plants and remain there while their development continues. The eggs hatch in late fall or early spring, depending on local temperature conditions. The emerging larvae feed for 3 or 4 weeks on the tips of the plants and later on the foliage. Then the larvae spin white, netlike cocoons around themselves and attach the cocoons to the alfalfa plants or to ground litter. After a week or two inside the cocoons, the pupae emerge as new adults and feed for a brief period. The insects become inactive during hot weather. They mate in the fall or the following spring, and the cycle continues.



Newly laid eggs are lemon yellow. When ready to hatch, they appear brownish.

A newly hatched larva is cream colored with a black head. Later, its body becomes light green with a white stripe down its back.

Each larva spins a cocoon around itself and develops into a pupa.

Alfalfa weevil pupa in a cut-open cocoon.

A newly emerged alfalfa weevil adult is tan with a broad dark stripe that may become brown to almost black as the insect ages.



Actual Sizes

○ Adult Weevil $\frac{3}{16}$ "

◊ Eggs $\frac{1}{50}$ "

○ Larva $\frac{3}{8}$ "

○ Cocoon $\frac{1}{4}$ "

Wasps Attack Weevils

In their native territory, populations of the alfalfa weevil are held in check by several species of parasitic wasps. Depending on their species, these wasps attack different life stages of the alfalfa weevil. One wasp lays its eggs on the outside of the weevil pupa. When the wasp eggs hatch, the young feed on the weevil, destroying it. The wasps mature through their own life cycle (eggs/larvae/pupae/adults) and, upon emerging as adults, seek mates. After copulation, the wasp females seek new alfalfa weevils to continue the cycle.



Unfortunately, when the alfalfa weevil entered the United States at the turn of the century, it did not bring along its natural enemies from Europe. Therefore, the weevil flourished.

Actual Sizes

<input type="radio"/>	Adult Weevil	$\frac{3}{16}$ "
<input type="radio"/>	<i>Microctonus colesi</i>	$\frac{3}{25}$ "
<input type="radio"/>	<i>Microctonus aethiopoides</i>	$\frac{3}{25}$ "

Microctonus aethiopoides, one of the parasites imported to control alfalfa weevil, lays eggs in an alfalfa weevil adult.

Parasite Importations Instead of Chemical Control

Early in the century, American scientists realized that natural parasites native to Europe might be able to control the alfalfa weevil here—if the parasites could become established in this country. But before importing any new species, scientists had to screen the parasites extensively to make sure that they could never become pests themselves. From 1911 through 1953, wasps that parasitize the alfalfa weevil were imported into the Western United States to a limited extent. And in 1959, the U.S. Department of Agriculture's (USDA) Agricultural Research Service (ARS) began importing the wasps in quantity for release in the East because the weevil had recently become a serious pest there.

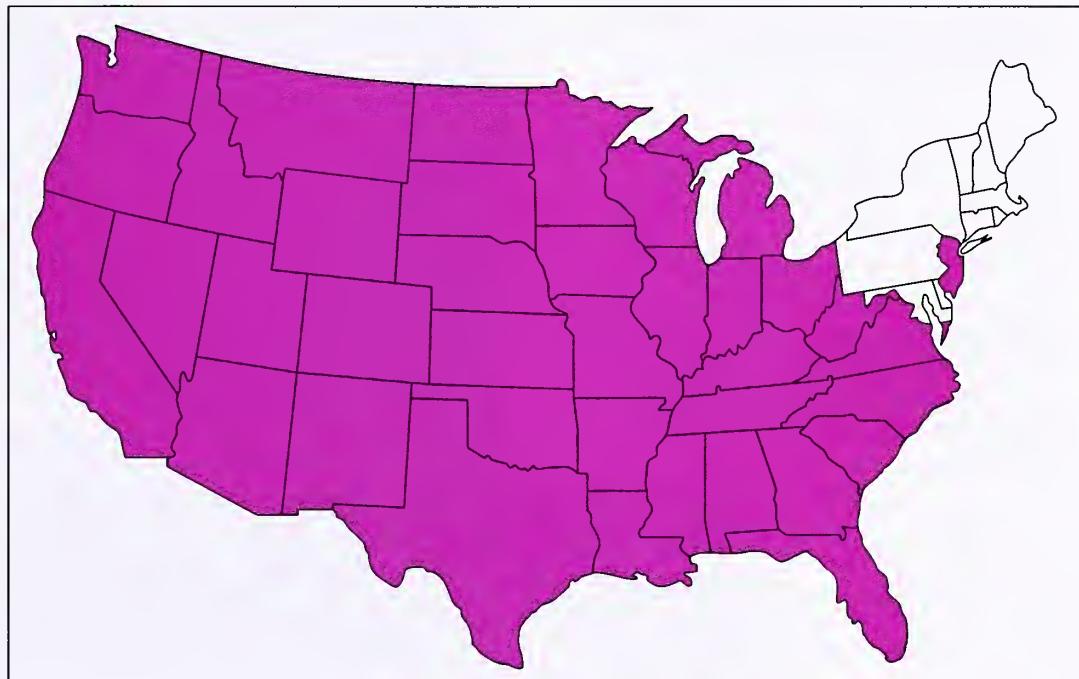
The purpose of this effort was to offer alfalfa farmers a nonchemical solution to their weevil problems. Biological control—using one life form to suppress populations of another—can reduce farmers' dependence on pesticides and, in turn, lessen the likelihood that pest species will develop resistance to the active ingredients in registered chemicals. Reducing the use of pesticides is particularly appealing in the case of alfalfa production because that crop is grown on 25 million acres of land from coast to coast.



Microctonus colesi (top) and *M. aethiopoides*—two species of parasitic wasps released to control the alfalfa weevil.

Wasps Do the Job

Where the imported wasps became established in the Northeast, they did an excellent job of controlling the alfalfa weevil. In 1986, ARS experts estimated that their program saved farmers \$49 million annually in crop damage and the cost of control efforts. Before this program, 96 percent of New Jersey alfalfa fields required the use of insecticides to prevent heavy weevil damage. After the parasites were introduced and established, only 7 percent of the fields required treatment.



States where alfalfa weevil parasites were released.

Redistributing the Parasites Throughout the Country

Based on ARS' success in the East, USDA decided to distribute parasites of the alfalfa weevil nationwide. This project was ideally suited for USDA's Animal and Plant Health Inspection Service (APHIS), with its national network of personnel. In 1980, APHIS began implementing the Alfalfa Weevil Biological Control Project in cooperation with State and Federal agencies, universities, grower organizations, and individual farmers.



Parasitized alfalfa weevil larvae and adults can be mass collected using easily constructed equipment.

Scope of the APHIS Project

The project was designed to ensure that parasites were distributed throughout all major alfalfa-producing areas in order to suppress alfalfa weevil populations throughout the United States. This was accomplished through an extensive program of survey, release, and evaluation conducted from 1980 through 1991.

APHIS personnel began the project by performing a detection survey to discover the distribution of weevil parasite species beyond the Northeast, where they were already well established. This survey also provided information about the distribution of the weevil itself.

Using information gathered from the detection survey, project personnel developed a release strategy to distribute each parasite species where it was lacking. Additional considerations included the ability of each species to become established in an area, multiply, and migrate to surrounding areas.

Project personnel released small starter colonies of parasites at scattered locations throughout each State involved. Timing was crucial. Because some parasitic wasps attack only certain life stages of the weevil, scientists coordinated the parasite liberations on a field-by-field basis. In advance, project personnel secured agreements from local land managers that fields chosen to receive parasites would not be sprayed with pesticides. Project participants hoped that the

parasites would migrate into nearby fields and, eventually, distribute themselves everywhere alfalfa is planted.

In all, six species of parasitic wasps were released during the project. Two of the species were mass-reared in the laboratory because they were not readily available in nature. The other four species were collected by personnel who harvested them from alfalfa fields in the form of parasitized weevil larvae or adults.



This surveyor is collecting a sample of alfalfa weevils to evaluate the success of the parasite introductions.

At more than 4,200 sites in a 38-State area, approximately 16.8 million parasites were released. From one to six species were released in each field, depending on the results from the detection surveys conducted at the start of the project.

To evaluate the success of the Alfalfa Weevil Biological Control Project, APHIS conducted a survey across the

Alfalfa weevil parasites were released at carefully selected sites.

middle of the country to examine the effects of the parasites on controlling alfalfa weevils. This evaluation survey also monitored the spread of the parasite species to areas adjoining the release fields. Data were gathered over several years and then analyzed. A 1989 report, "Economic Analysis of Alfalfa Weevil Biological Control," showed that biological control of the alfalfa weevil should produce net

benefits equal to \$88 million per year. Biological control of this pest directly benefits alfalfa producers and indirectly benefits all consumers of livestock products. The summary report indicated an expected benefit-to-cost ratio of 87:1 for the USDA cooperative project. Results showed a twofold increase of parasite species in these midwestern study sites. Increases in rates of parasitism were also found once establishment occurred. In Missouri and Iowa study sites, the parasitism rate of adult weevils increased from 11 percent (1981-83) to 30 percent (1984-87). Larval parasites can cause significant weevil mortality: in Ohio, more than 50 percent of the larvae sampled were parasitized by *Bathyplectes anurus*.

Project personnel also conducted parasite recovery surveys at all release locations to determine each species' success in establishing itself over time. Results from this survey and others show a dramatic increase in the range of the parasites since the project began in 1980. Recoveries reported through the end of 1990 total 78 new State records and 1,381 new county records for alfalfa weevil parasites.



Farmers: You Can Help

- Consider integrated pest management instead of relying solely on chemicals to control insect pests. Most insecticides kill beneficial insects, such as parasitic wasps, more readily than they kill pests, such as the alfalfa weevil. For this reason, integrated pest management systems—balanced combinations of biological and chemical control plus changes in crop management and care—are the most effective against pests in the long run.
- Learn more about biological control options for dealing with the alfalfa weevil. Contact your Extension Service agent to find out if parasites have been released in your area. Other resource contacts include entomologists at land-grant universities, personnel with your State department of agriculture, or specialists with the main APHIS office in your State. These contacts can give you an update on the status of biological control efforts in your area.

- Ask your Extension Service agent to help you decide if alfalfa weevils are causing enough damage to your crop to justify the use of chemical insecticides. The agent may suggest that you collect a random sample of alfalfa stems from your fields so he or she can carefully examine the samples to determine the true level of weevil-caused damage. Because this damage can be very conspicuous, small amounts might lead you to believe that insecticides are necessary when they are not. In the evaluation process, your agent will consider the number of weevil larvae per stem and days until harvest, the stand density, the estimated yield per acre and market value of the crop, and the cost of insecticide application.

- Spray fields only when absolutely necessary and on the advice of your Extension Service agent. If insecticides are applied only when necessary, parasites will be better able to increase in numbers. That will reduce the need for chemical control of alfalfa weevils.

All programs of the U.S. Department of Agriculture are available to anyone without regard to race, creed, color, sex, disability, religion, or national origin.

